Trace Chemical Contaminant Control System Performance Simulation

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Buildup of atmospheric trace contaminants in such closed habitats as a spacecraft cabin may lead to potentially serious health problems for its occupants. For this reason, control methods are implemented for minimizing contaminant concentrations to acceptable levels that ensure the occupants' long-term health and well-being. Designing such systems is difficult since temperature, humidity, and other environmental factors can affect their performance over time. Time-consuming and expensive testing is normally required to verify system capabilities before they can be used effectively. A means to minimize the need for large-scale testing has been developed.

Trace contaminant control can be achieved through various means. Typical technologies used onboard spacecraft include physical adsorption on granular-activated charcoal or other adsorbents, chemical adsorption using impregnated granular-activated charcoals and granular lithium hydroxide, ambient temperature catalytic oxidation, and high-temperature catalytic oxidation. Other significant means include absorption in water via condensing humidity and habitat leakage. Many of these techniques are used commercially in building construction and aircraft design. Usually, in order to design and evaluate the effectiveness of a chosen contamination control system, pilot-scale testing must be conducted. In order to reduce the need for large-scale, expensive tests to assess the many design parameters that must be addressed to achieve the most efficient design, a computer program has been developed that allows basic contamination control techniques to be simulated. Results from the program can be used in assessing different technology combinations, hardware sizing, and life-cycle economics. Commercial applications include building construction, industrial emissions control analyses, and aircraft ventilation system design. Computer program documentation has been developed, including a user's guide and a description of the current program version. With input and output manipulation via commercial spreadsheet programs, the simulation tool can be run on a personal computer. Program validation and uncertainty analyses have been conducted which demonstrate it delivers results within the observed uncertainty of contamination control system tests.

Perry, J.L. April 1994. A Users' Guide to the Trace Contaminant Control Simulation Computer Program. NASA TM–108456.

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